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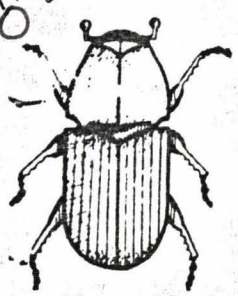

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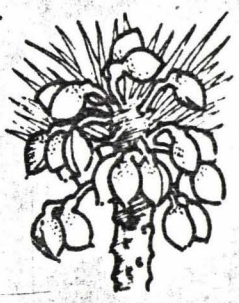

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EVALUATION OF THE DOUGLAS-FIR BEETLE INFESTATION IN THE NORTH FORK CLEARWATER RIVER DRAINAGE, IDAHO--1972

by

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ABSTRACT

The Douglas-fir beetle, *Dendroctonus pseudotsugae* Hopk., has caused extensive tree mortality for the third consecutive year in the North Fork Clearwater River drainage in northern Idaho. In 1972, the infestation encompassed about 494,080 acres of commercial forest lands in this drainage. It was estimated from a two-stage aerial photo-ground survey that 240,000 trees were killed during the 3-year period 1970-72, resulting in a loss of about 109 MMBF of Douglas-fir sawtimber. Infestation levels are expected to decline in 1973, but significant tree mortality is expected in localized infestation centers.

INTRODUCTION

The Douglas-fir beetle, *Dendroctonus pseudotsugae* Hopk., is the most destructive bark beetle of Douglas-fir, *Pseudotsuga menziesii* (Mirb.) Franco, in the Northern Rocky Mountain Region (Furniss and Orr, 1970). Observations of past outbreaks indicate that infestations of this beetle usually build up to epidemic status following some natural catastrophies such as extensive windthrow or drought, or in slash created during logging operations. Once populations build up in the above type host material or when the material dries out and becomes unattractive, beetles invade green, apparently healthy trees.

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EXPERIMENT STATION

Certain stand conditions such as overstocking, mature and overmature trees, as well as disease conditions may make stands more susceptible to attacking beetle populations. Once green trees are infested, the beetle population is able to maintain itself for 1 to 3 years, and then a decreasing trend usually occurs.

To determine impact of the Douglas-fir beetle on Douglas-fir stands in the North Fork drainage, a two-stage survey, using aerial photography followed by a ground cruise, was conducted in 1971 (Ciesla et al., 1971) and again in 1972 with some modification in methods. The survey was a cooperative effort involving resource managers from the Idaho Department of Public Lands, Potlatch Forests, Inc., Clearwater-Potlatch Timber Protective Association, Corps of Engineers, Intermountain Forest and Range Experiment Station, Clearwater and St. Joe National Forests, and entomologists from the Division of State and Private Forestry.

The objectives of this survey were to:

1. Verify the estimated number of trees killed and the volume loss caused by the Douglas-fir beetle in 1971.

2. Estimate the number of trees killed by the Douglas-fir beetle in 1972.

3. Estimate the volume loss caused by the Douglas-fir beetle in 1972.

SURVEY METHODS

A two-stage survey design was used which consisted of large-scale aerial photo samples corrected by a small ground sample. A series of 161 aerial photo points were established in a grid pattern every 2 miles in either direction over the 494,080-acre infestation (Fig. 1). In early July, stereo pairs with 60 percent overlap were taken at a scale of 1:8000 at each photo point by the Division of Engineering, U.S. Forest Service, Missoula, Montana. Photos were taken on a 9-inch format with a Zeiss-RMKA 15-23 aerial camera equipped with a 6-inch focal length lens and a K-36 CC filter. True color (Kodak SO 397) film was used.3/

One-hundred-acre plots, 20 by 50 chains, were located within the stereo overlap portion of each photo pair. Each plot was examined stereoscopically with an Old Delph scanning stereoscope by a photo interpreter, and a detailed count of the number of discolored Douglas-fir crowns was made in each 100-acre plot. Care was taken to separate western white pine, *Pinus monticola* Dougl., killed by either mountain pine beetle, *Dendroctonus ponderosae* Hopk., or white pine blister rust, *Cronartium ribicola* J. E. Fisher, and grand fir, *Abies grandis* Lindl., killed by fir engraver beetle, *Scolytus ventralis* Lec., from trees killed by Douglas-fir beetle.

3/ Mention of commercial trade names is for convenience only and does not imply endorsement by the U.S. Department of Agriculture.

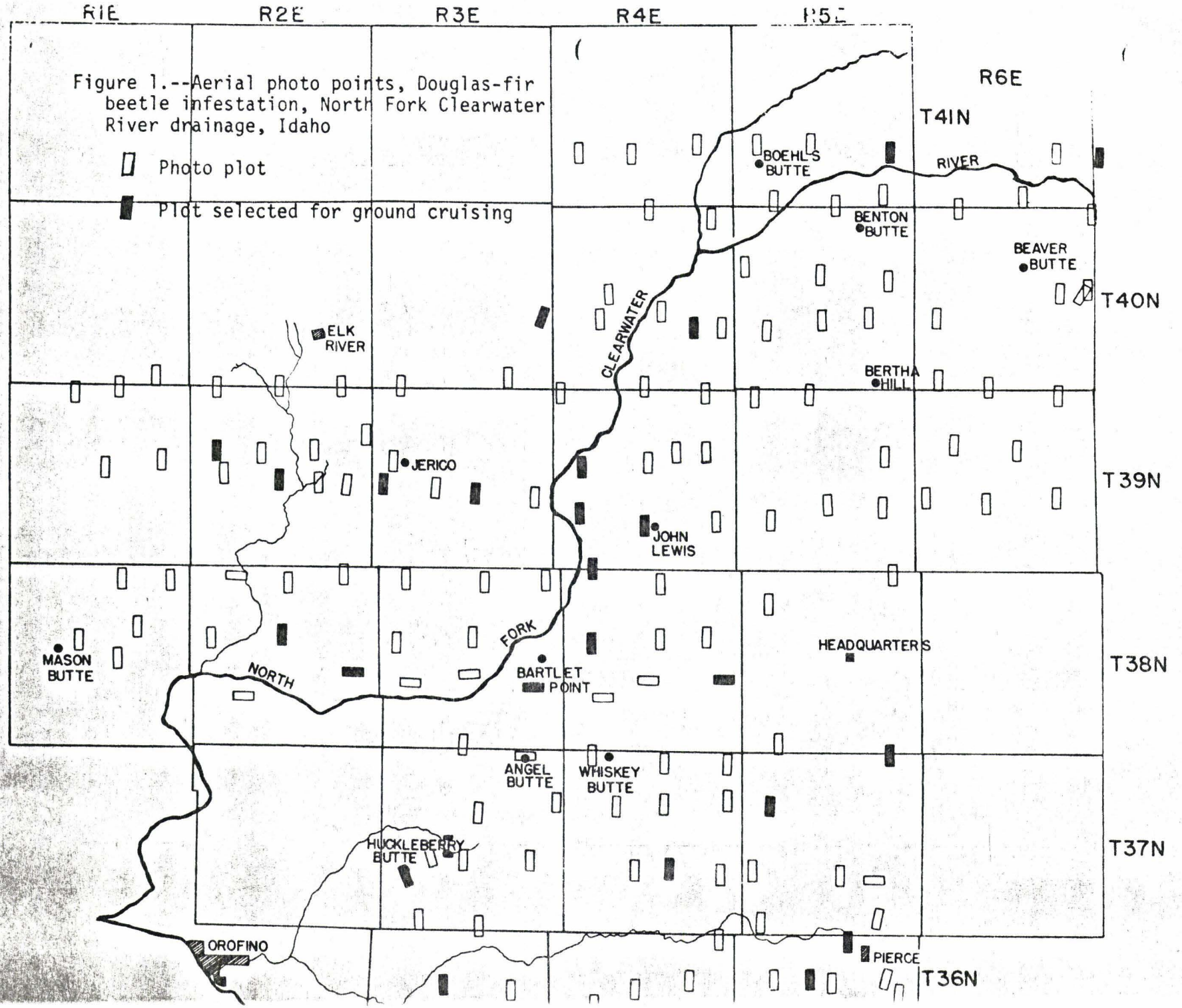

Figure 1.--Aerial photo points, Douglas-fir beetle infestation, North Fork Clearwater River drainage, Idaho

Twenty-four of the 161 photo plots were selected for ground cruising. Selection of ground cruise plots was made using the computer program PPSORT (Stage, 1971). With this program, plots are selected on a probability basis according to the number of Douglas-fir faders observed on the photo plot, and plots with the largest numbers of fader; have the greatest probability of being selected for ground cruising.

On each photo plot selected for ground truth, sample points were established at 5-chain intervals on cruise lines 5 chains apart, making a total of 40 sample points per 100-acre block. A variable plot cruise (BA = 20) was conducted at each sample point. Each tree falling into the variable plot was recorded by species, measured for diameter at breast height (d.b.h.) and total height, and was classified into one of the following five tree classes:

0 - green, uninfested

1 - attacked in 1972; green foliage, brood in cambium

2 - attacked in 1971; faded or red foliage, brood emerged

3 - snags; attacked prior to 1971

4 - pitchout; green foliage, callus galleries, no brood

Resultant data were analyzed by a modified ADP sale cruise and PPSORT programs. The output from the PPSORT program was incorporated with ground truth to provide summaries of infestation levels, volume losses by year, and residual stand composition. The photo interpretation data was correlated with ground survey data (Table 1) in order to obtain number of trees infested and volume loss by year.

An estimate of population totals was obtained by dividing the ground truth by the probability by which it was selected and incorporating output from the PPSORT program to measure population variance.

Table 1.--Summary of ground survey data, Douglas-fir beetle survey, North Fork Clearwater River, Idaho, 1972

Plot No.	Photo count	Pi Probability	Ground count Yi			
			1971 trees	1971 vol. (bd. ft.)	1972 trees	1972 vol. (bd. ft.)
6	78	1.0	379	2,066	151	17,151
18	26	.92662	165	44,341	82	5,145
21	32	1.0	203	77,548	122	55,926
30	30	1.0	94	6,012	213	52,688
32	58	1.0	60	71,100	345	93,435
36	7	.24947	--	--	102	53,140
45	3	.10691	--	--	--	--
49	8	.28511	--	--	28	24,967
55	40	1.0	--	--	--	--
57	18	.64150	--	--	--	--
61	20	.71278	--	--	--	--
67	13	.46331	--	--	75	14,559
78	5	.17819	--	--	--	--
89	4	.14255	--	--	--	--
91	1	.0356394	--	--	--	--
100	2	.0712788	--	--	--	--
116	10	.35639	--	--	--	--
142	14	.49895	--	--	40	20,697
147	61	1.0	109	33,206	71	40,180
152	29	1.0	94	33,421	--	--
155	21	.74842	90	50,402	48	17,022
157	42	1.0	45	33,761	232	128,530
159	17	.60587	42	24,636	70	29,813
160	7	.24947	36	27,233	--	--

RESULTS

The Douglas-fir beetle has killed in excess of 240,000 trees containing about 109 MM board feet of Douglas-fir in the North Fork drainage since 1970. The merchantable volume has been decimated greatly in some stands due to the nature of the beetle to group kill. In the John Lewis area on State of Idaho ownership, the volume loss is in excess of 12 MM board feet of commercial sawtimber on about 2,060 acres for the 3-year period 1970-72.[4/]

Impact on green stand.--Drainages within the North Fork contain a variety of commercial tree species. Douglas-fir is the most prevalent species next to grand fir, followed by western redcedar, *Thuja plicata* D. Don, and western white pine within plots surveyed in 1972 (Table 2). Plots surveyed are heavily stocked with Douglas-fir which comprises 24.3 percent of the total volume within the infestation. Grand fir makes up 39.1 percent of the volume, and western redcedar 13.0 percent.

Table 2.--Summary of ground survey data, plots 6-160, North Fork Clearwater River Douglas-fir beetle survey, 1972

Tree class	Species	Trees/ acre	Volume/ acre (bd. ft.)	Mean d.b.h.	Mean height
Green	Cedar	18.9	2,167	12.0	58.0
	Grand fir	37.7	6,525	11.0	69.0
	Western larch	6.0	1,446	13.0	108.0
	Lodgepole pine	.2	5	7.0	53.0
	W. white pine	6.7	2,111	13.0	90.0
	Ponderosa pine	.6	351	20.0	80.0
	Douglas-fir	34.9	4,049	11.0	66.0
Total green		105.0	16,654	12.4	74.8
1972 attack	Douglas-fir	.7	231	18.0	105.0
1971 attack	Douglas-fir	.5	168	16.0	87.0
Total		1.2	399	17.0	96.0

The Douglas-fir beetle killed approximately 17.6 percent of the merchantable Douglas-fir volume from 1970 through 1972 within the survey area. About 8.1 percent of the volume was killed in 1970, 3.9 percent in 1971, and 5.6 percent in 1972. The average diameter at breast height of attacked trees was 20 inches in 1970, 16 inches in 1971, and 18 inches in 1972. The average diameter for the Douglas-fir stand was 9 inches in 1971 in the plots ground cruised and 11 inches in 1972. This shows the preference for the Douglas-fir beetle to attack trees of larger diameter.

4/ Almas, D. P., 1972. Personal communication.

Resistant tree data.--Successfully attacked trees averaged 121+ years of age while in general, unsuccessfully attacked trees were of a younger age class and a smaller d.b.h. size class. Sixty percent of the trees attacked by the Douglas-fir beetle in 1972 were unsuccessfully attacked and contained no brood (Table 3); whereas, in 1971, 31 percent of the trees were unsuccessfully attacked. Ground cruise data from the twenty-four 100-acre blocks indicated the ratio of unsuccessful to successful attacks was 1.0:0.5 in 1972, compared to a 1:1 ratio in 1971.

Table 3.--Estimated Douglas-fir beetle pitchout trees, North Fork Clearwater River, 1972

Trees/acre	.246 ± .084[1/]
Volume/acre (bd. ft.)	74.30 ± 24.35
Total trees[2/]	121,909 ± 41,932
Total volume (bd. ft.)[2/]	36,714,100 ± 12,525,100
Volume/infested tree (bd. ft.)	329.8

1/ 1 S.E.

2/ Based on a gross area of 494,080 acres in survey unit.

Unsuccessfully attacked trees usually remain alive, but some may die, possibly as a result of fungi being introduced by attacking beetles. At this time, it is impossible to predict which unsuccessfully attacked trees will die.

An evaluation of 11 infested groups was conducted in late September and October in the North Fork drainage. This evaluation was for sampling Douglas-fir beetle brood for trend prediction purposes and will be presented in a separate report.

DISCUSSION AND CONCLUSIONS

Douglas-fir beetle populations were extremely heavy during the past 3 years with an estimated 240,000 trees being killed. Volume loss was in excess of 109 MM board feet of merchantable Douglas-fir.

Aerial photo estimates corrected by ground surveys showed a mean infestation level of 0.092 Douglas-fir per acre resulting in a volume loss of 32.43 board feet per acre occurring in 1971 (Ciesla, et al., 1971). In 1972, infestation levels increased to 0.133 trees per acre with a volume loss of 49.85 board feet per acre. Total loss for the 494,080-acre survey is estimated at 45,907 trees with 16,025,000 board feet loss in 1971 and 66,021 trees and 24,633,000 board feet killed in 1972 (Table 4). Percent sampling error was reduced from 36 percent to 28 percent using probability sampling instead of regression estimates.

Table 4.--Comparison of 1971 and 1972 Douglas-fir beetle survey data, North Fork Clearwater River, Idaho

	Year of attack		
	1970	1971[1/]	Total
	1971 Survey		
Trees/acre	.2379 ± .086[2/]	.3684 ± .108	.6063
Volume/acre (bd. ft.)	123.75 ± 40.94	177.75 ± 35.38	301.50
Total trees[3/]	68,515 ± 24,734	106,099 ± 31,087	174,614
Total volume (MBF)[3/]	34,640 ± 10,465	51,195 ± 10,290	85,835
Average volume/infested tree (bd. ft.)	520	482.5	491.6
	1971[1/]	1972	
	1972 Survey		
Trees/acre	.092 ± .002[2/]	.133 ± .033	.225
Volume/acre (bd. ft.)	32.43 ± 9.2	49.85 ± 16.01	82.28
Total trees[3/]	45,907 ± 11,860	66,021 ± 16,546	111,928
Total volume (MBF)[3/]	16,025 ± 4,551	24,633 ± 7,915	40,658
Average volume/infested tree (bd. ft.)	352.5	374.8	363.6

1/ Discrepancies due to factors listed below.
2/ 1 S.E.
3/ Based on a gross area of 494,080 acres in survey unit

A marked discrepancy was apparent between the number of trees tallied as being successfully attacked in 1971 and the number of faders (1971 attacks) that were tallied in the 100-acre blocks in 1972 (Table 4). Several factors that may account for the discrepancies are:

1. Approximately 25 to 36 MMBF of Douglas-fir was salvaged logged by the Idaho Department of Public Lands, Potlatch Forests, Inc., and the Clearwater National Forest. Salvage logging was concentrated in Douglas-fir beetle epicenters, resulting in the removal of many faders that would have been recorded in survey plots.

2. Increasing the acreage surveyed from 288,000 to 494,080 may account for some of the discrepancy in 1971 estimates between 1971 and 1972. Within the 206,080-acre increase in the survey, a considerable proportion is nonhost type and also susceptible type may have contained only light infestation.

3. Some trees attacked in 1971 may have faded early and lost their needles prior to when aerial photos and the ground survey were done; consequently, these trees could have been tallied as trees killed in 1970 or prior.

4. Many trees tallied by ground crews as successful attacks could have been pitchouts.

Infestation levels are expected to decline in 1973. This prediction is based on the nearly equal current brood/parent ratio of 1.1:1 in mid-October. Also, number of pitchouts increased from 31 percent in 1971 to 60 percent in 1972. Additional brood mortality will also occur from cold temperatures during winter, dispersal losses during beetle flight, predators, and additional "pitchout" mortality. These natural factors will further reduce the brood/parent ratio resulting in fewer attacking beetles in 1973.

Although the trend points toward a decreasing population trend, additional mortality in thousands of board feet may occur in hot spots as did occur in the John Lewis area west of Headquarters, Idaho, in 1972.

Salvage logging should be encouraged on all ownerships to further reduce the Douglas-fir beetle population level before beetle flight in 1973 and recover losses which have occurred.

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